

What is claimed is:

1. A method to produce chitin or chitosan by a fermentation process, comprising:
 - a) culturing in a fermentation medium a microorganism which comprises at least one genetic modification selected from the group consisting of:
 - i) a genetic modification that results in an increase in the activity of glutamine-fructose-6-phosphate amidotransferase;
 - ii) a genetic modification that results in an increase in the activity of glucosamine-6-P acetyltransferase;
 - iii) a genetic modification that results in an increase in the activity of chitin synthase;
 - iv) a genetic modification that results in an increase in the activity of chitin deacetylase;
 - v) a genetic modification that results in a decrease in the activity of *N*-acetylglucosamine-6-P deacetylase;
 - vi) a genetic modification that results in a decrease in the activity of glucosamine-6-P deaminase;
 - vii) a genetic modification that results in a decrease in the activity of chitinase; and
 - viii) a genetic modification that results in a decrease in the activity of chitosanase; and
 - b) collecting a product produced from the step of culturing which is selected from the group consisting of chitin and chitosan.
2. The method of Claim 1, wherein the glutamine-fructose-6-P amidotransferase is resistant to inhibition by UDP-*N*-acetylglucosamine.
3. The method of Claim 1, wherein the glutamine-fructose-6-P amidotransferase is resistant to inhibition by glucosamine-6-phosphate.
4. The method of Claim 1, wherein the glutamine-fructose-6-P amidotransferase is resistant to inhibition by glutamate.
5. The method of Claim 1, wherein the microorganism has a genetic modification that increases the activity of glutamine-fructose-6-phosphate amidotransferase, and wherein the genetic modification comprises transforming the

microorganism with a recombinant nucleic acid molecule encoding the glutamine-fructose-6-phosphate amidotransferase or a biologically active homologue thereof.

6. The method of Claim 5, wherein the recombinant nucleic acid molecule comprises the coding region of yeast, fungal, plant or animal *GFAI*.

7. The method of Claim 5, wherein the recombinant nucleic acid molecule comprises the coding region of bacterial GlmS.

8. The method of Claim 5, wherein the glutamine-fructose-6-phosphate amidotransferase is resistant to inhibition by UDP-*N*-acetylglucosamine.

9. The method of Claim 5, wherein the glutamine-fructose-6-phosphate amidotransferase is resistant to inhibition by glucosamine-6-phosphate.

10. The method of Claim 5, wherein the glutamine-fructose-6-phosphate amidotransferase is resistant to inhibition by glutamate.

11. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in an increase in the activity of glucosamine-6-P acetyltransferase.

12. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in an increase in the activity of chitin synthase.

13. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in an increase in the activity of chitin deacetylase.

14. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in an increase in the activity of chitin synthase and a genetic modification that results in an increase in the activity of chitin deacetylase.

15. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in a decrease in the activity of glucosamine-6-P deaminase.

16. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in a decrease in the activity of *N*-acetylglucosamine-6-P deacetylase.

17. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in a decrease in the activity of *N*-acetylglucosamine-6-P deacetylase and a genetic modification that results in a decrease in the activity of glucosamine-6-P deaminase.

18. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in a decrease in the activity of chitinase.

19. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in a decrease in the activity of chitosanase.

20. The method of Claim 1, wherein the microorganism comprises a genetic modification that results in a decrease in the activity of chitinase and a genetic modification that results in a decrease in the activity of chitosanase.

21. The method of Claim 1, wherein the microorganism is a fungus.

22. The method of Claim 1, wherein the microorganism is a yeast.

23. The method of Claim 1, wherein the microorganism is a yeast selected from the group consisting of *Saccharomyces* and *Schizosaccharomyces*.

24. The method of Claim 1, wherein the microorganism is a filamentous fungus.

25. The method of Claim 1, wherein the microorganism is a filamentous fungus selected from the group consisting of *Aspergillus*, *Absidia* and *Rhizopus*.

26. The method of Claim 1, wherein the microorganism is selected from the group consisting of *S. cerevisiae*, *A. niger*, and *A. nidulans*.

27. The method of Claim 1, wherein the genetic modifications increase the content of chitin or chitosan in the cell wall of the microorganism as compared to the wild-type microorganism by at least about 50%.

28. The method of Claim 1, wherein the genetic modifications increase the content of chitin or chitosan in the cell wall of the microorganism as compared to the wild-type microorganism by at least about 2 fold.

29. The method of Claim 1, wherein the genetic modifications increase the content of chitin or chitosan in the cell wall of the microorganism as compared to the wild-type microorganism by at least about 5 fold.

30. The method of Claim 1, wherein the genetic modifications increase the content of chitin or chitosan in the cell wall of the microorganism as compared to the wild-type microorganism by at least about 10 fold.

31. The method of Claim 1, wherein the step of collecting comprises treatment of microorganism cells with a hot alkaline solution, collection and washing of the remaining

solids containing chitin or chitosan, resuspension of the washed solids in an acidic solution to solubilize the chitin or chitosan, and precipitation of the chitin or chitosan.

32. A microbial biomass comprising chitin and/or chitosan and produced by the method of Claim 1.

33. A genetically modified microorganism comprising at least two genetic modifications selected from the group consisting of:

- a) a genetic modification that results in an increase in the activity of glutamine-fructose-6-phosphate amidotransferase;
- b) a genetic modification that results in an increase in the activity of glucosamine-6-p acetyltransferase;
- c) a genetic modification that results in an increase in the activity of chitin synthase;
- d) a genetic modification that results in an increase in the activity of chitin deacetylase;
- e) a genetic modification that results in a decrease in the activity of *N*-acetylglucosamine-6-P deacetylase;
- f) a genetic modification that results in a decrease in the activity of glucosamine-6-P deaminase;
- g) a genetic modification that results in a decrease in the activity of chitinase; and
- h) a genetic modification that results in a decrease in the activity of chitosanase.

34. The genetically modified microorganism of Claim 33, wherein the genetically modified microorganism is a filamentous fungus.

35. The genetically modified microorganism of Claim 33, wherein the genetically modified microorganism is a yeast.